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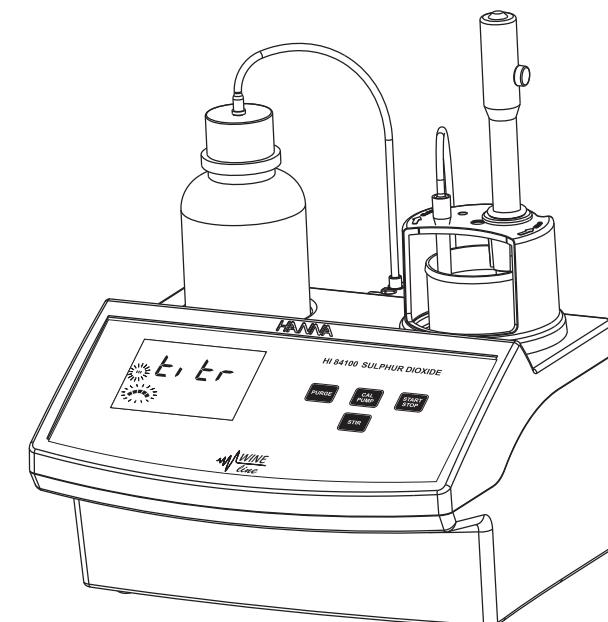
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For e-mail contacts and a complete list of Sales and Technical offices, please see
www.hannainst.com.

Instruction Manual

HI 84100 FREE & TOTAL SULPHUR DIOXIDE MINITRATOR for wine analysis



MAN84100
10/08

HANNA
instruments®
www.hannainst.com

WARRANTY

HI 84100 is warranted for two years against defects in workmanship and materials when used for its intended purpose and maintained according to the instructions.

This warranty is limited to repair or replacement free of charge.

Damage due to accident, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact your dealer. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred.

If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization Number from the Customer Service Department and then send it with shipment costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

To validate your warranty, fill out and return the enclosed warranty card within 14 days from the date of purchase.

Dear Customer,

Thank you for choosing a Hanna product. This manual will provide you with the necessary information for the correct use of the instrument. Please read it carefully before using the meter. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com. This instrument is in compliance with CE directives.

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PRELIMINARY EXAMINATION

Please examine this product carefully. Make sure that the instrument is not damaged. If any damage occurred during shipment, please notify your Dealer.

Each **HI 84100** minititrator is supplied complete with:

- Reagents set for 20 titrations
- Two 50 mL beakers
- Two 20 mL beakers
- Scissors
- Tubes set with cap
- ORP probe
- Stir bar
- Power cable
- One 30 mL bottle of Refill Solution
- One 1 mL syringe
- Two sachets of cleaning solution for wine deposits
- Two sachets of cleaning solution for wine stains
- Instruction manual

Note: Save all packing material until you are sure that the instrument works correctly.
Any defective item must be returned in its original packing.

GENERAL DESCRIPTION

The **HI 84100** is a low-cost, easy to use, microprocessor-based automatic titrator that benefits from Hanna's years of experience as a manufacturer of analytical instrumentation.

The instrument incorporates a simple and reliable peristaltic pump which ensures high dosing repeatability. Pump calibrations, performed with the provided Hanna standards, assure the accuracy of the instrument.

The instrument comes pre-programmed with an analysis method designed for Free and Total Sulphur Dioxide measurements for wine analysis. The instrument uses a powerful algorithm which analyzes the shape of the electrode response in order to determine when the titration reaction has reached completion.

The **HI 84100** provides a simple user interface. Simply pressing the START STOP button automates the analysis, performs all necessary calculations and immediately displays the titration results in convenient units.

ACCESSORIES

REAGENT SETS

HI 70300L	Electrode storage solution (500 mL)
HI 70635L	Cleaning solution for wine deposits (500 mL)
HI 70636L	Cleaning solution for wine stains (500 mL)
HI 7082	Electrode filling solution (4 X 30 mL)
HI 84100-50	Titrant solution (100 mL)
HI 84100-51	Alkaline reagent (500 mL)
HI 84100-52	Acid reagent for Total SO ₂ determination (500 mL)
HI 84100-53	Acid reagent for Free SO ₂ determination (500 mL)
HI 84100-54	Stabilizer reagent (25 pcs.)
HI 84100-55	Calibration standard (500 mL)

OTHER ACCESSORIES

HI 3148B /50	ORP probe with 50 cm cable
HI 70483T	Tube set with cap for titrant bottle and tip
HI 731319	Stir bar 25x7 (10 pcs.)
HI 740036P	Beaker 50 mL (10 pcs.)
HI 740037P	Beaker 20 mL (10 pcs.)
HI 740198	Power cable

Recommendations for Users

Before using this product, ensure that it is suitable for both your application and for the environment in which it will be used.

Operation of this instrument may cause unacceptable interferences to other electronic equipment. This requires the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the EMC performance of the instrument.

To avoid damages or burns, do not put the instrument into a microwave oven. To ensure the safety of the operator and the instrumentation do not use or store the instrument in hazardous environments.

For faster response, unscrew the fill hole screw during measurements.

STORAGE PROCEDURE

To minimize clogging and assure a quick response time, the glass bulb and the junction of the electrode should be kept moist and not allowed to dry out.

Replace the solution in the protective cap with a few drops of **HI 70300** Storage Solution or, in its absence, Filling Solution (**HI 7082**). Follow the Preparation Procedure before taking measurements.

Note: NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.

PERIODIC MAINTENANCE

Inspect the electrode and the cable. The cable used for connection to the instrument must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. Connectors must be perfectly clean and dry. If any scratches or cracks are present, replace the electrode. Rinse off any salt deposits with water.

Probe Maintenance

Refill the reference chamber with fresh electrolyte (**HI 7082**). Allow the electrode to stand upright for 1 hour. Follow the Storage Procedure above.

CLEANING PROCEDURE

- *Wine deposits* Soak in Hanna **HI 70635** cleaning solution for 15 minutes
- *Wine stains* Soak in Hanna **HI 70636** cleaning solution for 15 minutes

IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte and soak the electrode in **HI 70300** Storage Solution for at least 1 hour before taking measurements.

SIGNIFICANCE OF USE

Wine makers add sulphur dioxide to wine in order to inhibit bacteria and wild yeast, and to serve as an antioxidant to prevent browning.

A small portion of the free sulphur dioxide, known as molecular SO₂, is active and responsible for protecting wine.

The relationship between the amount of SO₂ added and the amount of free SO₂ in wine is complex. It is clear, however, that the relationship is largely governed by the total SO₂ content of the wine. The exact relationship between free and bound (total - free) SO₂ will vary from wine to wine.

When SO₂ is added to wine some immediately becomes bound.

The remaining unbound SO₂ is called "free" and is divided in two parts.

The larger, and relatively ineffective free portion is called "bisulphite" (HSO₃⁻).

The smaller portion of the free sulphur dioxide, known as molecular SO₂, is active and responsible for protecting wine.

The amount of molecular SO₂ in wine depends on both the level of free SO₂ present as well as the pH. For instance, at pH 3.2, the amount of free SO₂ for 0.8 ppm molecular SO₂ is 22 ppm. At pH 3.5, you will need 43 ppm free - essentially double.

Free SO₂ concentration (ppm) for 0.8 ppm molecular SO₂:

pH	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
Free SO ₂	14	18	22	28	35	44	55	69	87	109

In most bulk storage and at bottling situation 0.8 ppm molecular SO₂ provides adequate protection from oxidation and bacterial action (including malolactic).

It is important to remember that the amount of free SO₂ in the wine depends on three things: how much is added, how much was present before the addition and how much of your addition promptly becomes bound.

The level at which molecular SO₂ can be detected by the human senses is about 2.0 ppm.

This is also the level which is needed for maximum protection of wine.

This is particularly true in the case of sweet, and most notably, botrytised wines.

The **HI 84100** makes it possible to test free or total SO₂ in all the wines including the red, which are difficult to test with manual methods due to the indistinct color changes associated with traditional endpoint indication.

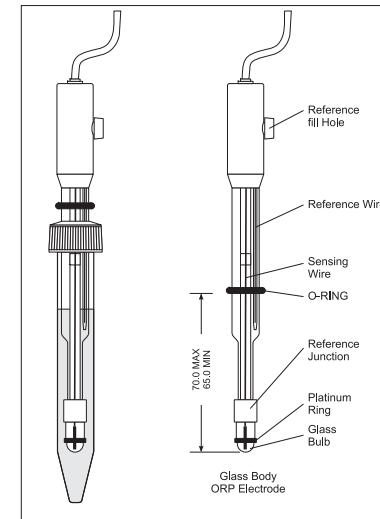
SPECIFICATIONS

Range	0 to 400 ppm of SO ₂
Resolution	1 ppm
Accuracy	5% of reading or ± 1 ppm
Method	Ripper titrimetric method
Principle	Equivalence point redox titration
Sample volume	50 mL
ORP Electrode	HI 3148B (included)
Pump debit	0.5 mL/min
Environment	0 to 50 °C (32 to 122 °F); max 95% RH non-condensing
Power supply	220V/50Hz; 10VA
Dimensions	208 x 214 x 163 mm (8.2 x 8.4 x 6.4") (with beaker)
Weight	2200 g (77.6 oz.)

REQUIRED REAGENTS

Code	Description	Quantity/test
HI 84100-50	Titrant (for Free & Total SO ₂)	
HI 84100-51	Alkaline Reagent (for Total SO ₂)	5 mL
HI 84100-52	Acid Reagent (for Total SO ₂)	5 mL
HI 84100-53	Acid Reagent (for Free SO ₂)	5 mL
HI 84100-54	Stabilizer (for Free & Total SO ₂)	1 packet
HI 84100-55	Standard (for Free & Total SO ₂)	50 mL

ELECTRODE CONDITIONING & MAINTENANCE



PREPARATION PROCEDURE

Remove the protective cap of the ORP electrode (HI 3148B).

DO NOT BE ALARMED IF SALT DEPOSITS ARE PRESENT. This is normal with electrodes. They will disappear when rinsed with water.

During transport, tiny bubbles of air may form inside the glass bulb affecting proper functioning of the electrode. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

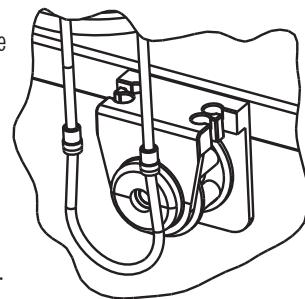
If the bulb and/or junction is dry, soak the electrode in HI 70300 Storage Solution for at least one hour.

If the filling solution (electrolyte) is more than 2½ cm (1") below the fill hole, add HI 7082 3.5M KCl Electrolyte Solution.

PUMP TUBE REPLACEMENT

Follow the step below to safely remove the peristaltic pump tubing:

- Detach the old tube system from the reagent bottle.
- Purge the pump to remove any residual titrant from the tubing.
- Grasp one fixing ring of the peristaltic pump tube.
- Detach tubing from pump housing.
- Remove the other side of the tube.



Follow the step below to mount new peristaltic pump tubing:

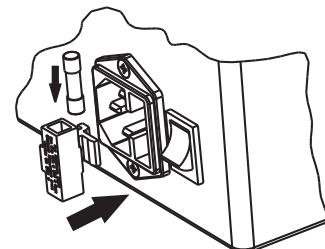
- Position one peristaltic pump fixing ring on its location.
- Stretch the tube over the peristaltic pump cylinders.
- Fix the second pump fixing ring on its location.
- Attach the tube to the reagent bottle.

Note: Purge the peristaltic pump until drops of reagent appears on the dosing tip by pressing the PURGE button.

FUSE REPLACEMENT

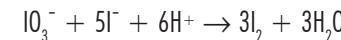
To change the fuse follow next steps:

- Disconnect the power cord from the rear panel of the instrument.
- Pull out the fuse holder located near the power cord connector.
- Replace the fuse with a similar one.
- Push the fuse holder with the fuse in the appropriate place.

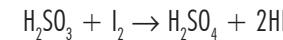


PRINCIPLE OF OPERATION

The HI 84100 determines the free and total sulphur dioxide concentration in wine using the Ripper method. Excess iodide added to the wine sample reacts with iodate introduced by the titrant to produce iodine *in situ*.



The iodine produced in the sample then reacts with sulphur dioxide in the wine according to the redox reaction below:

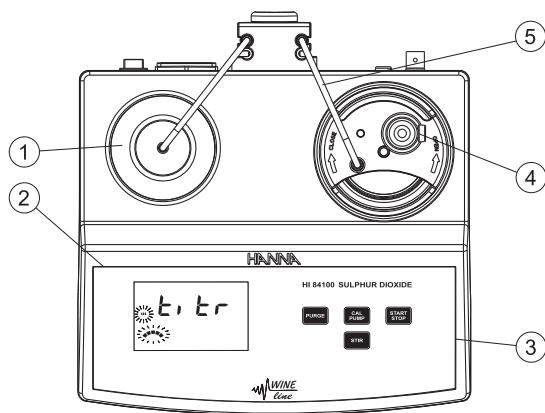


The HI 84100 utilizes an ORP electrode to monitor the above redox titration. The integrated algorithm detects the equivalence point associated with reaction completion. The volume of titrant required to reach the equivalence point is used, along with the titrant concentration, to calculate the sulphur dioxide concentration in the wine sample.

FUNCTIONAL DESCRIPTION

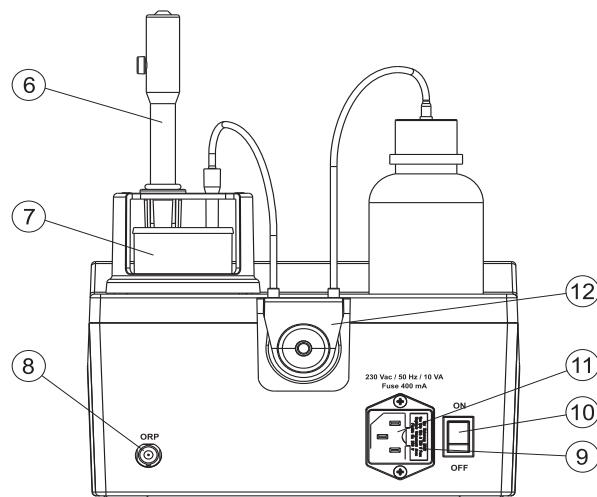
INSTRUMENT DESCRIPTION

FRONT PANEL



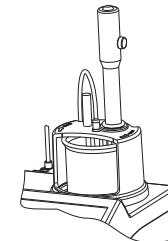
- 1) Titrant bottle
- 2) Liquid Crystal Display (LCD)
- 3) Keypad
- 4) Electrode holder
- 5) Peristaltic pump tube

REAR PANEL



- Place the probe holder on the top of the beaker and secure by turning clockwise.

- Rinse the ORP electrode with deionized water, open the refill cap and immerse into the stirring sample until the teflon reference junction is completely submerged. Be sure that the tip of the electrode is not in the path of the stir bar.



- Purge the titrant into a waste beaker for 1-2 seconds to ensure that the dosing tip is filled with fresh titrant solution.

- Insert the dosing tip into the titrant tube sleeve. IT IS CRITICAL THAT THE TIP BE IMMersed APPROXIMATELY 1.5 CM INTO THE SOLUTION BEING TITRATED.



- Fill the 20 mL beaker up to the 5 mL mark with the HI 84100-52 Acid Reagent, add the contents to the 50 mL beaker containing the sample.



- Add the contents of one HI 84100-54 Stabilizer powder packet to the beaker containing the sample.



- Press START STOP to start the titration. The LCD will display "titr" as well as stirrer and pump tags to indicate a titration in progress.



- At the end of the titration the sulphur dioxide concentration is displayed in ppm (mg/L).

- Add the contents of one packet of **HI 84100-54 powder Stabilizer** to the sample beaker.



- Press START STOP to start the titration. The LCD will display "titr" as well as stirrer and pump tags to indicate a titration in progress.



- At the end of the titration the sulphur dioxide concentration is displayed in ppm (mg/L).



TOTAL SO₂ MEASUREMENT PROCEDURE

- Fill the 50 mL beaker up to 50 mL mark with the wine sample.

Note: It is important to be accurate in your measurement of wine sample. Pipettes are recommended.



- Place the stir bar in the beaker and put the beaker in the minititrator top.

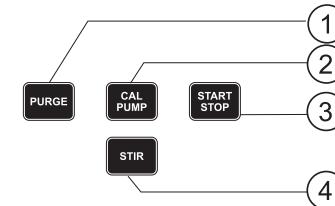
- Fill the 20 mL beaker up to the 5 mL mark with the **HI 84100-51 Alkaline Reagent**, add the contents to the 50 mL beaker containing the sample.



- Swirl the beaker and wait for 15 minutes.
- Place the beaker into the beaker holder.

- 6) ORP Electrode
- 7) Beaker
- 8) BNC electrode connector
- 9) Fuse
- 10) Power switch
- 11) Power cable connector
- 12) Peristaltic pump

KEYPAD DESCRIPTION



- 1) PURGE - to start/stop purging (max purging time is 5 min)
- 2) CAL PUMP - to enter pump calibration mode
- 3) START STOP - to start/stop titration or pump calibration
- 4) STIR - to start/stop the stirrer while in main screen or purging mode

LCD DESCRIPTION



- 1) Stability indicator: when the pump calibration is in progress
- 2) Stirrer active tags
- 3) Calibration messages
- 4) Pump active tags
- 5) Four digit secondary display
- 6) "Time" tag: when the time is displayed on the secondary display
- 7) "ppm" tag: when the titration result is displayed on the primary display
- 8) Four digit and half main display

START UP

- Place the instrument on a flat surface. Do not place the instrument in direct sunlight.
- Plug the titrator into an outlet with a proper ground connection and the correct voltage and frequency. (See the label on rear panel of instrument).
- Connect the peristaltic pump tubing to the pump. (See the Pump Tube Replacement Section).
- Remove the bottle cap shipped with the reagent and replace with the bottle cap included with the tubing set.
- Place the reagent bottle in the appropriate place on the titrator top.
- Connect the inlet tube to the reagent bottle and the outlet tube to the dosing tip.
- Turn the instrument ON using the power switch located on the rear panel of the instrument and wait until dashes are displayed on the LCD.

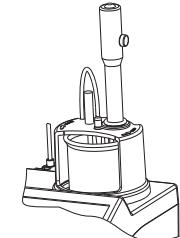
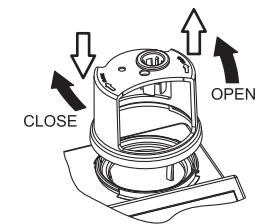
FREE SO₂ MEASUREMENT PROCEDURE

- Using a clean pipette, fill the 50 mL beaker up to 50 mL mark with the wine sample.



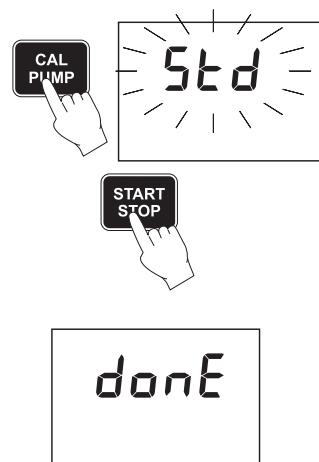
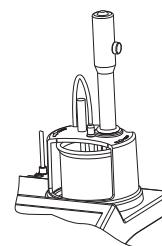
Note: Failure to use clean pipettes will result in erroneous readings.

- Place the stir bar in the beaker and put the beaker in the minititrator top.
- Place the beaker into the beaker holder.
- Place the probe holder on the top of the beaker and secure by turning clockwise.
- Rinse the ORP electrode with deionized water, open the refill cap and immerse into the stirring sample until the teflon reference junction is completely submerged. Be sure that the tip of the electrode is not in the path of the stir bar.
- Purge the titrant into a waste beaker for 1-2 seconds to ensure that the dosing tip is filled with fresh titrant solution.
- Insert the dosing tip into the titrant tube sleeve. IT IS CRITICAL THAT THE TIP BE IMMERSED APPROXIMATELY 1.5 CM (0.6") INTO THE SOLUTION BEING TITRATED.
- Fill the 20 mL beaker up to the 5 mL mark with the HI 84100-53 Acid Reagent, add the contents to the 50 mL beaker containing the wine sample.



Note: Be aware of any air bubbles in the tube it could effect the results.

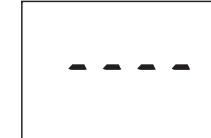
- Rinse the ORP electrode with deionized water, open the refill cap and immerse into the stirring sample until the teflon reference junction is completely submerged. Be sure that the tip of the electrode is not in the path of the stir bar.
- Purge the titrant into a waste beaker for 1-2 seconds to ensure that the dosing tip is filled with fresh titrant solution.
- Insert the dosing tip into the titrant tube sleeve. IT IS CRITICAL THAT THE TIP BE IMMERSED APPROXIMATELY 1.5 CM (0.6") INTO THE SOLUTION BEING TITRATED.
- Fill the 20 mL beaker up to the 5 mL mark with the **HI 84100-53 Acid Reagent** and add the content to the 50 mL beaker.
- Add the contents of one packet of **HI 84100-54 powder Stabilizer** to the sample beaker.
- Press CAL PUMP button "STD" will appear on display.
- Press START STOP in order to start the system calibration.
- At the end of the calibration, DONE appears for a few seconds and the meter returns to the measurement mode.
- Promptly remove the probe and dispensing tip from the sample solution and rinse with deionized water.



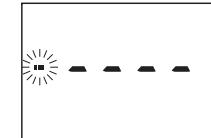
GUIDE TO DISPLAY CODES



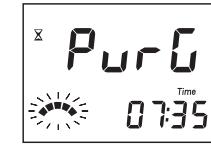
This prompt appears for a few seconds each time the instrument is turned ON.



Main screen display.

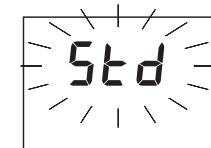


Main screen display with stirrer active.

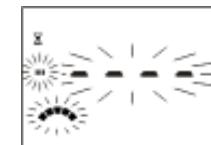


Purging mode message.

PUMP CALIBRATION MESSAGES



This screen appears when the meter enters pump calibration mode. Pump calibration is initiated by pressing the START STOP button.



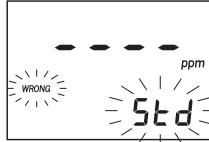
This screen appears while pump calibration is in progress. Pressing CAL PUMP or START STOP button, the minititrator returns to the main screen.



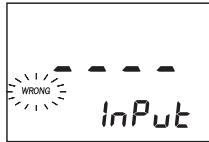
This screen appears when pump calibration is complete.



This error message appears during pump calibration when the equivalence point can not be reached. Change the pump calibration standard and try again.



The calibration process was attempted using the wrong standard solution.



This error message appears when the input reading (mV) exceeds the input limits ($0 < \text{input (mV)} < 1000$).

TITRATION MESSAGES



This screen appears when the minititrator enters TITRATION mode. Press the START STOP button to stop the titration and return to the main screen.



The titration result, expressed as the concentration of sulphur dioxide in ppm (mg/L), is displayed at the end of the titration process. Press the START STOP button to return to the main screen.



This error message appears when the input reading (mV) exceeds the input limits ($0 < \text{input (mV)} < 300$), when titration starts up and ($0 < \text{input (mV)} < 1000$) during titration.



This screen appears when the sample concentration exceeds 400 ppm.

TIPS FOR AN ACCURATE MEASUREMENT

The instructions listed below should be followed carefully to ensure measurements are conducted with the highest possible accuracy and precision.

- IT IS CRITICAL THAT THE TIP BE IMMersed APPROXIMATELY 1.5 CM INTO THE SOLUTION BEING TITRATED.
- Use a clean, volumetric pipette to measure and transfer the 50 mL wine samples into the titration beaker.
- The peristaltic pump must be allowed to complete a full 5 minutes purging cycle prior to performing a pump calibration.
- Calibrate the peristaltic pump prior to each series of measurements.
- Calibrate the peristaltic pump if the meter is left idle for several hours.
- Analyze the wine sample immediately after the sample is obtained.
- Clean the electrode with HI 700635 or HI 700636 cleaning solutions specially designed for the wine industry.

PUMP CALIBRATION PROCEDURE

Attention: Pump calibration must be performed each time the pump tube, the reagent bottle or the ORP electrode is changed. A pump calibration is recommended before each set of measurements or after the titrator is left idle for several hours.

- Using a clean pipette, fill the 50 mL beaker up to the 50 mL mark with HI 84100-55 Standard.

Note: Failure to use clean pipettes will result in erroneous readings.

- Place the stir bar in the beaker and put the beaker in the minititrator top.
- Place the beaker into the beaker holder.
- Place the probe holder on the top of the beaker and secure by turning clockwise.

